AN EXTERNAL METAL SUPPORT FOR DIRECT APPLICATION TO THE SHAFT OF A FRACTURED LONG BONE.

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David J., a laborer, forty-five years of age, while working in a steel foundry on the 26th of December, 1901, was injured by a heavy steel beam falling across the left upper arm. A few hours later I saw him at St. Luke's Hospital in a condition of mild shock with a temperature of 98.6, a pulse of 80, and a respiration of 24. It was quite evident on first inspection that the arm had been about as badly damaged as was possible without it being completely severed from the body. On the anterior aspect was a large irregular wound through which one end of the humerus protruded, while the other extremity of it stuck out of a similar lesion on the posterior surface of the arm. The skin was torn for a distance of about two-thirds the circumference of the arm, the anterior wound reaching obliquely to the fold of the elbow, while the posterior extended longitudinally from the middle of the arm almost to the shoulder. More than half of the muscular substance seemed to be divided transversely and the bone, in addition to being the seat of a compound fracture as just mentioned, was also splintered for a short distance. The great vessels and nerves were not seen, though it is presumable that most of them escaped serious injury, since the pulse at the wrist and sensation over the lower arm and hand were practically uninterrupted. From the above somewhat inexact description, it will be seen, at least, that so much of the continuity of the member had been interrupted as to make the question of saving it a very grave and doubtful one. The patient was anæsthetized at once, the ends of the humerus squared off and united by a through and through wire, necessitating some two inches of shortening. All blood clots, shreds of tissue and dirt were removed, but no attempt at primary suture of the soft parts was made, owing to their crushed, devitalized condition. A rubber tube was drawn clear through the arm, the anterior and posterior defects stuffed out with gauze, and a very large aseptic dressing applied. No attempt was made at any form of permanent splint, since it was found that the soft parts over the two extremities of the humerus had been so extensively damaged as to make it a matter of impossibility to encircle one or both of them in such a manner as to insure support. Hence, as I say, I contented myself with merely wiring the bones to keep their ends from further damaging surrounding structures, and devoted my efforts to averting a general infection until some form of mechanical support for the bones could be devised and applied. The day after the operation the patient's condition was satisfactory in every particular, and on the second day his temperature arose to 101.6, the highest which was recorded during his convalescence. Four days after the injury he commenced to suffer great pain in the injured member, and this persisted until the ninth day, when the parts were placed at rest in the manner now to be described:

With the arm flexed at the elbow I applied a plaster bandage which included the chest, forearm and hand, the upper arm being left free, of necessity. A steel arch anchored at one end in the plaster enclosing the chest, and at its other in the bandage around the forearm, was suspended just above the upper arm. Beneath this arch was placed a vertical rod, which had attached to its lower extremity the silver splint shown in cut No. 1. This rode upon the ends of the bone like a saddle upon a horse, and prevented their natural tendency to rise up out of the wound, while an extension of the vertical rod fitted between the ends of bone, thus keeping the apparatus from gliding toward shoulder or elbow. However, under the influence of this direct splint the free bony ends showed a decided tendency to point downward and project through the gap on the posterior surface of the arm. Hence five days later a silver wire was passed under each extremity and carried out through the anterior wound, to be attached to the steel arch above After this was done the humerus remained absolutely rigid, there was no difficulty in dressing the large anterior wound by stuffing gauze in around the rod and the wires, the patient was occasioned absolutely no inconvenience by the apparatus, and except for tightening the wires as they stretched the appliance caused us no concern during all the weeks that it remained in place. It is worthy of note that there was no more spontaneous pain after the application of the splint, although there had been a great deal before. Six weeks after the injury a new plaster bandage was applied, this time the arm straight at the elbow, but the silver splint and the wire swings were left in position. At the expiration of seven weeks the two silver wires which had held the bone up were removed, and I was delighted to find that there was now no longer any tendency for the splint to force the humerus downward, showing that there

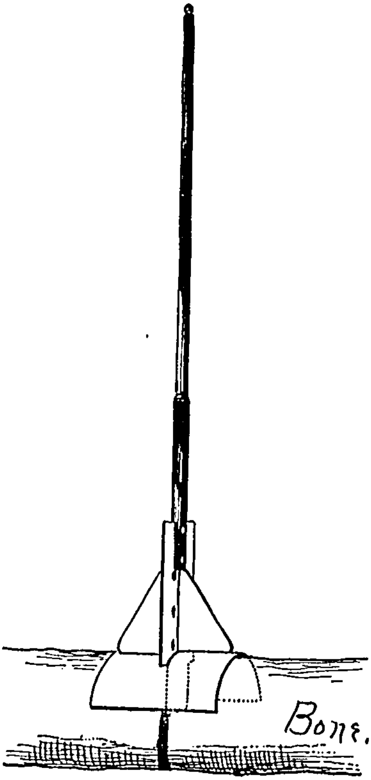

FIG. 1.

must be a reasonably firm union of some sort. It was, however, not until eight weeks had elapsed after the injury that I ventured to remove the anterior silver splint, when, to my great satisfaction, it was found that there was a decidedly firm union, although at this time it cannot have been a bony one, for the bone could be slightly bent at the point of fracture. Three days later the bone suture was removed for fear that it could not remain without symptoms, in what had been for so long a time an infected wound. Though all supports of every sort were out of the wound and the bone was reasonably firm and seemingly in good condition, the arm was now apparently a shapeless and useless mass of tissues, so long had it lain in splints. The hand and fingers were so œdematous that the patient could not bend any of the joints in them, and hence our efforts from this time were to reëstablish the physiological functions of the part. On March 7th, that is, ten weeks after the injury, the patient sat up for the first time, and two days later the last cast was removed from the arm. On March 17th,—that is, almost twelve weeks after he was hurt, it was necessary to anæsthetize him and break up the adhesions which had formed in all the joints. It was possible to do this without disturbing the newly formed union at the site of fracture and as a consequence a considerable degree of motion was possible in all of these joints which had previously been stiff. On the 10th of April, fifteen weeks after the injury, the patient was discharged from the hospital. There was still some œdema of the hand, though all the wounds were healed, and he possessed something like half motion in all of the joints. Six months later I saw the man, and was gratified to note that he could feed himself, take off his hat and put it on, and otherwise perform most of the functions which are expected of a healthy arm. The amount of strength now possessed by the member cannot be better shown than by adding that he can carry a hod full of coal or a bucket full of water without discomfort and without the slightest evidence of movement in the shaft of the injured bone. Dr. Clopton has made an examination with the fluoroscope, and tells me that he found the bone ends in perfect apposition, the axis of the shaft relatively straight, and presumes, from the fact that an extremely heavy shadow was cast by the callus, that the union at that time must have been bony in nature.

It is of interest in this connection to review briefly the various methods which have been adopted for the accomplishment of a firm union in compound fractures or those which have failed to unite primarily. These may be best divided into two groups, the first of which shall include the various appliances which can be completely incorporated within the extremity, and the second group made up of those which communicate with the exterior of the part. Under the first heading come the various forms of wires, nails, screws, plates, etc. Boeckel was the first to use ordinary screws in approximating the ends of oblique fractures, and is said to have accomplished some very desirable results in this manner. A double nail was used by Gussenbauer. This was an appliance shaped somewhat like a broad letter U, and each extremity of it penetrated a half of the fractured bone. Some sort of an ivory or absorbable bone rod was inserted into the marrow at the site of fracture by Bircher, and Von Bruns. Senn introduced a valuable aid in the treatment of oblique fractures of the thigh when he proposed his bone rings a few years ago at a meeting of the American Surgical Association. So enthusiastic over this proposition was Rickets that he termed Senn's bone rings the most rational means yet proposed of treating this form of injury. Ivory plates were tacked or screwed to the fractured bone by Sick, while similar plates of silver or other metal have been used, and in many instances with excellent results by Agnew, Redard, Steinbach, Martin, and White. In some respects the most nearly physiological, hence, the most nearly perfect of all the appliances which have been incorporated into the structure of a fractured part, is a bony flap. This has been successfully performed by Wolff, Mueller and Scheuer. This last-named author transplanted a rib into the shaft of the humerus, dividing the pedicle fourteen days later, and in this way accomplished a perfect result. This practically completes the list of the heteroplastic and autoplastic methods which have been advised for repairs of this kind.

Of the appliances which have held broken bones together, and at the same time communicated with the external world, but one has met with a marked degree of success up to the present time. I refer to Parkhill's clamp, which consists of four parallel screw rods, two of them being driven through each portion of the bone and then held together outside the arm by wing-plates. The second appliance which I will mention as having a similar end in view is the one which I have presented herewith. The appliances to be incorporated will be passed with a mere mention since they have in reality no bearing upon the discussion at hand. In comparing these two methods, which contemplate an open wound and a communication with the exterior, I have no word of criticism for the Parkhill apparatus. The excellent results obtained by Parkhill, and with the same apparatus by Bennett, speak for themselves; but I will state that my appliance is decidedly the simpler of the two, can be quickly and cheaply made anywhere by anyone, and is certainly easier to apply than the other. It is surely not a very easy matter to drill four holes perfectly parallel, as must be done in applying the Parkhill apparatus. Again, the application of it takes some little time and must often be done during the shock which supervenes upon a serious injury, and last, but not least, the relation of the parts must be considerably disturbed in order to carry out the process.

As I have stated, it is a very simple matter to place my apparatus in position. All that is necessary is to square off the ends of the bones a very little, hang a wire under each, and place the little saddle upon them. Furthermore, it is extremely easy to remove the entire apparatus when its purpose has been accomplished. In the case at hand this was done without the use of any anesthetic, general or local, and the patient complained of no pain whatever. There was no necrosis as a result of pressure, and I must express myself as pleased in every way with the result accomplished. I claim further for this simple procedure a far wider field of usefulness than is possible where any of these other devices are used. The proposer of each of these others has been careful to state that a well-fitting plaster cast or other splint must be applied to the portion of the extremity injured in order that his apparatus may best subserve its function. Now, it will be remembered that in my case the soft parts were injured from the shoulder to the elbow, making it manifestly impossible to apply any sort of splints which might remain in position anywhere between the two points mentioned. My only possible points of anchorage were the chest and the forearm; hence, it will be seen that the device here employed meets the requirements of cases in which all methods must fail which depend in any sense upon a permanent cast applied between the shoulder and the elbow. There is no reason why it cannot be used in a fracture of the thigh, or in one of any other long bone for that matter, and I especially recommend it in just those most extensively lacerated cases where an extremity might be lost or permanently deformed if any dependence had to be placed upon an external splint for the part.